GATES LEARJET CORPORATION

maintenance manual

CHAPTER

31

INDICATING / RECORDING SYSTEMS

Chapter Section Subject	Page	Date
31-Title		
*31-List of Effective Pages	1	Apr 30/82
31-Contents	1	Dec 18/81
31-20-00	1	Dec 18/81
31-20-01	201	Dec 18/81
31-20-02	201	Dec 18/81
31-30-01	1	Dec 2/77
31-30-01	2	Dec 2/77
31-30-01	3	Dec 2/77
31-30-01	501	Dec 2/77
31-30-01	502	Dec 2/77
31-30-01	503	Dec 2/77
31-30-01	504	Dec 2/77
31-30-01	505	Dec 2/77
31-50-01	1	Dec 2/77
31-50-02	1	Dec 2/77

Chapter Section Subject	Page	Date

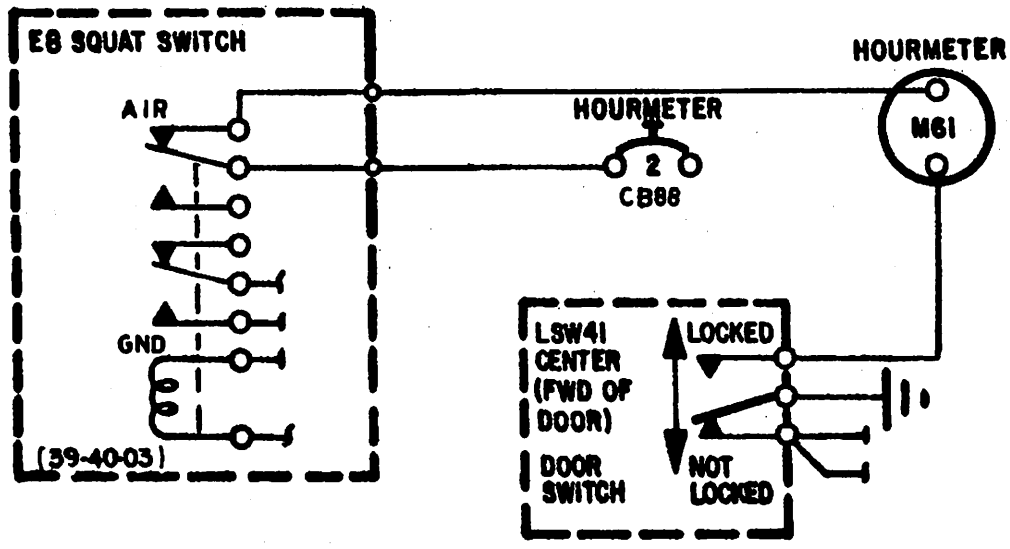
Insert Latest Revised Pages; Destroy Superseded or Deleted Pages.
*Asterisk indicates pages revised, added or deleted by current revision.
The portion of the text affected by the current revision is indicated by a vertical line in the outer margin of the page.

Subject	Chapter Section Subject	Page
INDEPENDENT INSTRUMENTS - DESCRIPTION AND OPERATION	31-20-00	
Description	31-20-00	1
Operation	31-20-00	1
CLOCK - MAINTENANCE PRACTICES	31-20-01	
Removal/Installation	31-20-01	201
HOUR METER - MAINTENANCE PRACTICES	31-20-02	
Removal/Installation	31-20-02	201
FLIGHT RECORDER - DESCRIPTION AND OPERATION	31-30-01	
General	31-30-01	1
Description	31-30-01	1
Operation	32-30-01	1
FLIGHT RECORDER SYSTEM - ADJUSTMENT/TEST	31-30-01	
General	31-30-01	501
Tools and Equipment	31-30-01	501
Adjustment/Test	31-30-01	501
AURAL WARNING UNIT - DESCRIPTION AND OPERATION	31-50-01	
General	31-50-01	1
Operation	31-50-01	1
GLARESHIELD WARNING LIGHT SYSTEMS - DESCRIPTION AND OPERATION	31-50-02	
General	31-50-02	1

INDEPENDENT INSTRUMENTS - DESCRIPTION AND OPERATION

1. Description
 A. Independent instruments consist of components or systems which are not related to any major systems of the aircraft.
 (1) The clock is a conventional stem-wound, spring-actuated eight-day unit. A knob is located in the lower left portion of the clock face for winding and resetting. A clock is installed in the pilot's and copilot's instrument panels.
 (2) The hour meter system consists of a 28 vdc circuit breaker installed in the copilot's circuit breaker panel and an hour meter installed in the copilot's instrument panel or in the tailcone.

2. Operation (See figure 1)
 A. A ground circuit to the hour meter is completed when the cabin door is closed and latched. A 28 vdc circuit to the hour meter is completed through a set of contacts in the squat switch relay panel when the aircraft is airborne.



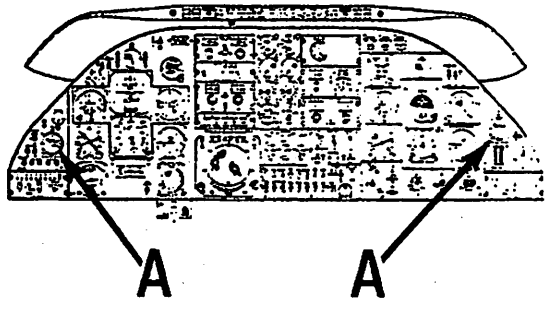
Hour Meter Electrical Schematic
Figure 1

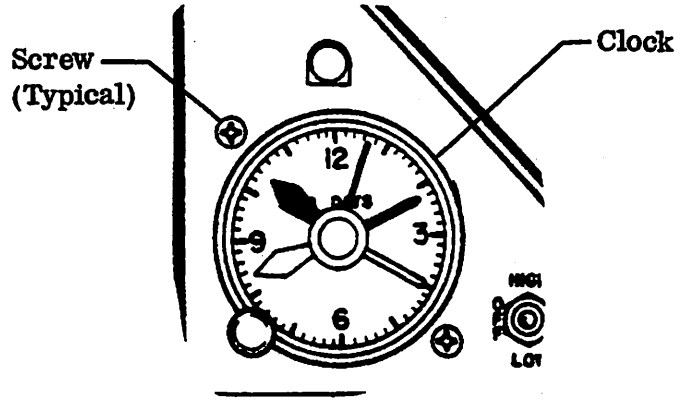
CLOCK - MAINTENANCE PRACTICES

1. Removal/Installation

 A. Remove Clock (See figure 201)
 (1) Assure that Battery and Stall Warning Switches are OFF.
 (2) Lower either instrument panel.
 (3) Remove screws and clock from instrument panel.

 B. Install Clock (See figure 201)
 (1) Install clock and secure with attaching parts.
 (2) Raise and secure instrument panel.





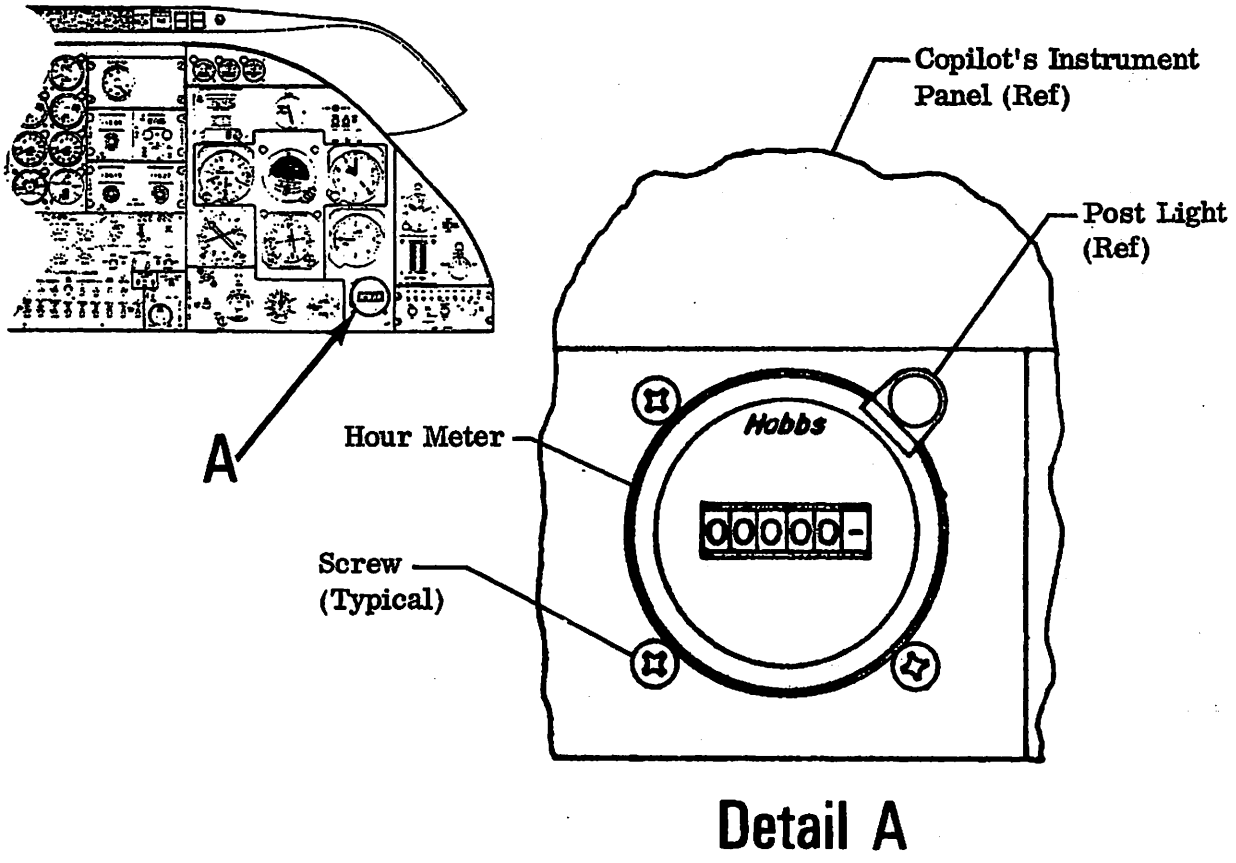
Typical Clock Installation

Detail A

Eight-Day Clock
Figure 201

HOUR METER - MAINTENANCE PRACTICES

1. Removal/Installation
 - A. Remove Hour Meter (See figure 201)
 - (1) Remove electrical power from aircraft.
 - (2) Loosen quick release fasteners and pull hour meter panel out of copilot's instrument panel.
 - (3) Disconnect electrical connector from hour meter and remove meter from aircraft.
 - (4) Remove attaching parts and hour meter from meter panel.
 - B. Install Hour Meter (See figure 201)
 - (1) Install hour meter in meter panel and secure with attaching parts.
 - (2) Connect electrical connector to hour meter.
 - (3) Install hour meter panel assembly on copilot's instrument panel and secure with quick release fasteners.
 - (4) Restore electrical power.



Hour Meter
Figure 201

FLIGHT RECORDER - DESCRIPTION AND OPERATION

1. General
 A. The flight recorder is installed to automatically record the following aircraft parameters: airspeed, altitude, vertical acceleration, heading and elapsed time. The recorder parameters may be analyzed by maintenance personnel to establish overhaul and maintenance requirements or in the event of an accident, establish the cause.
 B. The flight recorder system consists of a flight recorder, an auto-event marker, an accelerometer and circuit breakers.

2. Description
 A. On Aircraft 25C/F equipped with the Flight Recorder System, the flight recorder, event marker, accelerometer and pitot static accumulator assemblies are installed on the baggage floor at approximate aircraft center line.
 B. On Aircraft 25B/D equipped with the Flight Recorder System, the flight recorder is installed on the RH side of the baggage compartment. The accelerometer is installed on the floor in front of the baggage compartment floor. The event marker is installed on the forward side of frame 21 at approximate water line 39.00.

3. Operation
 A. When power is applied to the aircraft and the flight recorder circuit breakers are depressed, flight recorder operation is automatic.
 B. The accelerometer provides signals proportional to vertical acceleration forces occurring to the aircraft. The accelerometer is calibrated to respond to acceleration forces from -3G to +6G along its vertical axis.
 C. The flight recorder consists of four subsystems: drive, altitude and airspeed, heading indicator and accelerometer indicator.
 (1) The drive subsystem provides a smooth continuous drive for the foil record assembly. The amount of foil on the take-up spool increases with each revolution of the take-up spool, foil speed varies from 6 inches per hour at start to 12 inches per hour after 200 hours of flight recorder operation. As the foil is transported, styli of the applicable subsystems emboss the foil.
 (2) The flight recorder includes a time-remaining counter system. The time-remaining counter is a Veeder-Root counter which is mounted on the front panel assembly. The counter indicates the time remaining in hours and should be reset when the foil is replaced (normally 200 hours).
 (3) The flight recorder verification-of-operation signal (beep) is a keyed 400-cps tone. The rate changes proportionally with the elapsed time from the start of the foil spool, and varies from approximately 8 per minute at the start to 20 per minute after

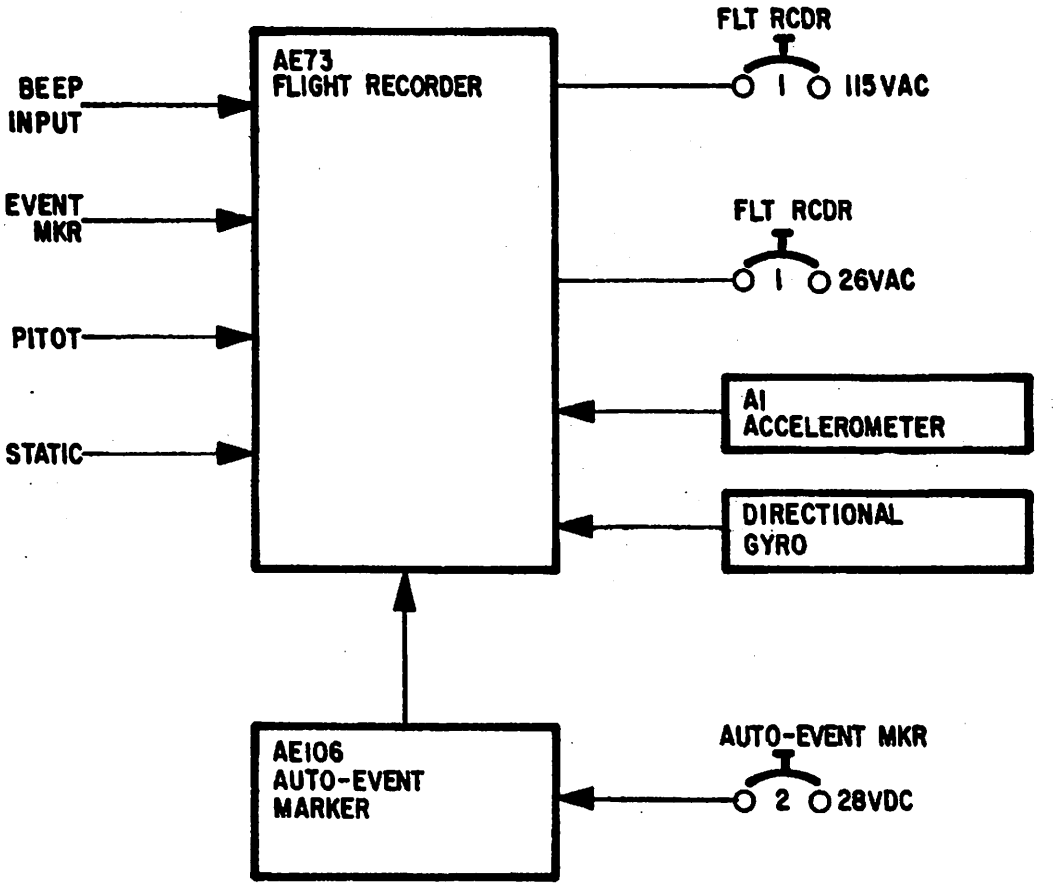
200 hours of recording time.

(4) The altitude and airspeed subsystem consists of a gas-tight housing which contains two independently functioning bellows assemblies. Fittings on the gas-tight housing provide connection to aircraft pitot and static lines. Each of the bellows assemblies drives a stylus which embosses the foil.

(5) The heading indicator subsystem consists of the heading indicator assembly and the electronics related to heading servo amplification. The input signal to the heading indicator subassembly is obtained from the aircraft directional compass and is connected directly to the heading indicator subassembly heading synchro. If the heading synchro rotor is not electrically aligned with the directional compass synchro, an error signal is developed in the heading synchro. The error signal is applied to the input of the heading servoamplifier circuit where the error signal is amplified to a level sufficient to drive the heading servo motor. The servo motor direction of rotation depends upon the phase of the error signal. When the heading servo motor has driven the heading synchro rotor to correspond to the aircraft heading, the error signal is reduced to zero and heading servo motor rotation stops.

(6) The accelerometer indicator subassembly comprises the accelerometer servo assembly and electronics applicable to accelerometer servo amplification. Input for this subsystem is obtained from the Flight Recorder system remote accelerometer. The remote accelerometer is a differential transformer with its output connected in series with the stator windings of the accelerometer servo assembly synchro transmitter. Thus any output from the remote accelerometer generates a signal that is applied to the accelerometer servoamplifier input. The amplifier raises the level of the signal to a value sufficient to drive the accelerometer motor-generator until a null is created between the remote accelerometer output and the linear induction potentiometer output. Thus, the summation signal is returned to zero and accelerometer servo motor-generator rotation is stopped.

D. For further information on the flight recorder system refer to Overhaul Manual, Model 109-D Flight Recorder, published by the Lockheed Aircraft Service Company, Ontario, California.



Flight Recorder Block Diagram
Figure 1

FLIGHT RECORDER SYSTEM - ADJUSTMENT/TEST

1. General
 A. The following procedures are for the Lockheed, Model 109-D Flight Recorder System.
 B. The pitot-static system must be functionally checked prior to checking the flight recorder system. Refer to 34-11-00.

2. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Pitot and Static System Tester	MB-1	Aircraft Products Co. Bridgeport, Pa.	Pitot Static check.
Turn Table Assembly	TN26409	Gates Learjet	For directional gyro check.
Extension Cable		Fabricate Locally	
External Power Source	----	Commercially Available.	
Linear Scale	4024511-1	Lockheed Aircraft Service Co.	
Spool & Foil	4020538-1	Lockheed Aircraft Service Co.	

3. Adjustment/Test
 A. Functional Test of Lockheed 109-D Flight Recorder System.
 (1) Perform operational check of pitot-static system. Refer to 34-11-00.

 CAUTION: DO NOT APPLY PRESSURE FASTER THAN 20 KNOTS PER SECOND.

 ASSURE THAT THE FLIGHT RECORDER PNEUMATIC PITOT SELECTOR IS SET TO OPEN.

 (2) Connect pitot-static tester to pilot's and copilot's pitot tubes and static system and apply pitot pressure to give an indication of 300 knots airspeed. Block off other static ports.
 (3) Turn off pressure and seal the system. System pressure drop shall not exceed 5 knots in 5 minutes.

 CAUTION: DO NOT RELEASE PRESSURE FASTER THAN 20 KNOTS PER SECOND.

CAUTION: ASSURE THAT THE PITOT-STATIC TESTER CROSS-BLEED IS OPEN TO PREVENT DAMAGE TO AIRCRAFT INSTRUMENTS AND TESTER AIRSPEED INDICATOR.

NOTE: Assure that the flight recorder pneumatic static selector is in the open position.

(4) Open the tester cross-bleed.
(5) Apply vacuum to the copilot's static system until the tester altimeter indicates 28,000 feet.
(6) Shut off vacuum and seal the system. The altimeter should not indicate less than 27,440 feet in one minute.
(7) Release the vacuum on the system slowly, at a rate within the range of the aircraft rate-of-climb indicator.

CAUTION: TO PREVENT DISENGAGEMENT OF ALTITUDE STYLUS ARM BALL AND SOCKET JOINT (INSIDE HOUSING), USE CARE WHEN INSTALLING OR REMOVING FOIL RECORD ASSEMBLY.

(8) The foil record assembly must be held at an angle of approximately 30 degrees from vertical as the slotted legs are engaged with the alignment rod in the recorder mounting plate. It may then be pivoted until vertical and secured by tightening the knob nearest the centerline of the recorder. Likewise, on removal, the foil record assembly is released by loosening the knob nearest the recorder centerline, carefully tilting the foil record assembly at least 30 degrees from vertical, then lifting it off.
(9) The foil record assembly is serially matched in calibration to the particular recorder with which it is to be used. Check that the serial number on the foil recorder assembly matches the serial number of the flight recorder.
(10) Remove magazine from flight recorder and replace existing spool with a spool of test foil. Lightly scribe a start line on the test foil before inserting magazine into flight recorder.
(11) Remove secondary directional gyro from aircraft. Refer to 34-22-00.
(12) Install secondary directional gyro on turn table and connect to aircraft wiring with patch cable.
(13) Connect external power to the aircraft.
(14) Set Battery Switches to "on".
(15) Set Inverter Switches to "on".
(16) Assure that flight recorder 115 and 26 vac circuit breakers are depressed.
(17) Assure that Auto-Event Marker 28 vdc circuit breaker is de-

pressed.

(18) Insert headset phone plug in monitor jack.

(19) Verify 400 cycle beep tone is audible in headset. The beep signal is the flight recorders verification-of-operation.

NOTE: The rate of tone interruptions changes proportionately with the elapsed time from the start of the foil spool, and varies from approximately 20 per minute at the start of a full spool to 80 per minute after 200 hours of recording time.

(20) Remove headset.

(21) Select the proper event marker. Energize the selected event marker at the beginning and end of each segment or check point of the test being performed.

(22) Auto-Event Marker is initiated by depressing the pilot's or copilot's microphone PTT button.

(23) Use the manual event marker for this test.

(24) Remove mounting screws from accelerometer.

(25) Place accelerometer in the positions as shown in table 1. Allow accelerometer to rest in each position for not less than one minute.

Accelerometer Physical Position	Acceleration Position in Degrees	Acceleration in G's	Tolerance
Connector facing up	0	1.0	±0.2 G
Connector facing outboard	90	0.0	±0.2 G
Connector facing down	180	-1.0	±0.2 G

TABLE I

(26) Install accelerometer on mounting bracket and tighten screws securely.

(27) Use the pilot's Auto-Event Marker for this test.

(28) Assure secondary directional gyro circuit breaker is depressed and wait three minutes for system to synchronize. Set the SLAVE-FREE Switches to the "FREE" mode of operation.

(29) Position the turn table with secondary directional gyro to four cardinal headings = N, E, S, W (±1) degree. Refer to table II.

(30) Allow gyro to remain at each heading for not less than three minutes.

Heading	DEGREES	Tolerance
N	360	±3°
E	90	±3°
S	180	±3°
W	270	±3°

TABLE II

(31) Pull the secondary directional gyro circuit breaker. Permit the gyro to coast down in speed before removing the directional gyro. Remove secondary directional gyro from turn table and install in aircraft, maintaining the gyro level during movement.
(32) Use the copilot's Auto-Event Marker for designated test points.
(33) Connect the pitot-static tester to the pilot's and copilot's pitot tube and static system. Block off other static ports.
(34) Adjust the pitot-static tester to obtain the readings listed in table III. Seal off tester and allow pressure to remain at each test point value for not less than one minute

Pitot

Airspeed Knots	Tolerance ± Knots
100	10
200	10
250	10
300	10

TABLE III

Static

Altitude Feet	Tolerance ± Feet
2, 000	100
10, 000	150
20, 000	300
40, 000	600

TABLE IV

(35) Adjust the pitot static tester to obtain the readings listed in table IV. Seal off tester and allow vacuum to remain at each test point value for not less than one minute.
(36) Disconnect pitot-static tester from pitot copilot's static system and remove tape from static ports.

(37) Pull the FLT RCDR and AUTO-EVENT MKR circuit breakers. Set the Battery Switches to OFF and disconnect external power source from aircraft.

(38) Remove magazine from flight recorder and replace test foil with new foil. The time-remaining counter should be manually reset to indicate the minimum time remaining for recorder operation (normally 200 hours) whenever the foil is replaced. The time-remaining counter is a Veeder-Root counter which is mounted on the panel of the flight recorder front cover assembly (or front panel assembly).

(39) Use scale overlay on test foil and evaluate recorded tracings for sequential directions and values against input data. Refer to tables I, II, III and IV for trace tolerances. Refer to Calibration Chart furnished with each flight recorder. Insure that all foil tracings are legible.

(40) Check test foil for all Event Marker tracings, time marks (minutes, quarter hour and hour marks), aux. trace and reference line.

AURAL WARNING UNIT - DESCRIPTION AND OPERATION

1. General
 A. The aural warning unit is located on the aft side of frame 5 at approximately aircraft centerline.

2. Operation
 A. Cabin altitude aural warning is obtained when a ground signal is applied to pin B of 71. (Refer to 31-50-01 in the Wiring Manual) The tone is applied to the audio system. The tone varies approximately 700 cps within a frequency range of 1680 to 3360 cps every 0.3 (±0.06) seconds. When 28 vdc is applied to pin K, P71 (reset) the tone will cease for approximately 60 seconds before starting again.
 B. Mach aural warning is obtained when a ground is applied to pin H of P71. The tone increases approximately 900 cps within a frequency range of 1900 to 3000 cps every 1.5 seconds. The tone is applied to the audio system. The mach aural warning will continue until corrective action has been taken.
 C. The autopilot disengage aural warning is obtained when 28 vdc is removed from pin F of P71. The tone is 550 cps and lasts approximately one second. The tone is applied to the audio system.
 D. The gear aural warning is obtained when a ground is applied to pin D of P71. The tone is a continuous 220 cps tone and is applied to the audio system. The tone may be muted by holding the TEST-MUTE Switch on the gear control panel to MUTE.

GLARESHIELD WARNING LIGHT SYSTEMS - DESCRIPTION AND OPERATION

1. General
 A. The glareshield warning light system provides the crew members with a visual indication of a system condition.
 B. The warning light panel is located in the center of the glareshield and contains warning (red), caution (amber), indicator (green) and spare (white) lights.
 C. Each light on the glareshield has a legend which describes the appropriate system malfunction. Red lights indicate a warning malfunction, requiring immediate corrective action. Amber lights indicate a caution malfunction and require attention, but not immediate action. The warning light on the glareshield will remain lighted until corrective action is taken.
 D. The glareshield warning lights are controlled by the warning light control box assembly which is located on the aft side of frame 5 at the aircraft centerline. All electrical connections are made by two electrical connectors.
 E. Bulb replacement is accomplished by pulling the lens assembly out and removing the bulb. Refer to bulb replacement (33-00-00) for bulb part number.